

**CLAIMS:**

1. A method of generating a representation of the compositional distribution of a chemical sample as a function of depth, comprising:
  - irradiating the sample with radiation having a plurality of frequencies in the range from 25GHz to 100THz;
  - detecting radiation reflected from and/or transmitted by said sample to obtain a time domain waveform;
  - obtaining frequency data as a function of time from the time domain waveform;
  - deriving the representation from the frequency data.
2. A method of generating a representation of the granularity of a chemical sample as a function of depth, comprising:
  - irradiating the sample with radiation having a plurality of frequencies in the range from 25GHz to 100THz;
  - detecting radiation reflected from and/or transmitted by said sample to obtain a time domain waveform;
  - obtaining frequency data as a function of time from the time domain waveform;
  - deriving the representation from the frequency data.
3. The method according to any preceding claim wherein the sample is a pharmaceutical sample.
4. The method of any preceding claim wherein frequency data as a function of time is obtained from the time domain waveform using a Gabor transform.
5. The method of claim 4 wherein the Gabor transform is implemented using a windowed Fourier transform, a correlation of a specific kernel function or a filter-bank.
6. The method of claim 4 or 5 further comprising applying the Gabor function to the time domain waveform and selecting frequency, window type and/or window width of the Gabor function to optimise spectral or temporal features.

7. The method according to any preceding claim wherein the compositional distribution representation is a three dimensional representation.
8. The method according to any preceding claim further comprising:
  - subdividing the sample to be imaged into a two-dimensional array of pixels,
  - detecting radiation from each pixel;
  - obtaining a time domain waveform for each pixels; and
  - obtaining frequency data as a function of time for each pixel from the respective time domain waveforms;
  - deriving a representation as a function of depth at each pixel from the respective frequency data; and
  - combining the representations for each pixel into a three dimensional compositional distribution representation for the sample.
9. The method according to any preceding claim further comprising:
  - subdividing the sample to be imaged into a two-dimensional array of pixels,
  - detecting radiation from each pixel;
  - obtaining frequency data as a function of time for each pixel from the respective time domain waveforms;
  - deriving a cross-sectional compositional representation from the respective frequency data.
10. The method of any preceding claim wherein the radiation is pulsed.
11. An apparatus for creating a three dimensional compositional distribution representation of a chemical sample, the apparatus comprising:
  - emitter for irradiating the sample with radiation having a frequency in the range from 25GHz to 100THz;
  - detector for detecting radiation reflected from and/or transmitted by the sample at a plurality of pixels and producing a time domain waveform for each pixel;
  - means for obtaining frequency data as a function of time from the time domain waveform for each pixel;

means for deriving a compositional representation as a function of depth from the frequency data for each pixel; and

means for combining the representations for each pixel to generate the three dimensional compositional distribution representation.

12. The apparatus of claim 11 wherein the sample is a pharmaceutical sample.
13. The apparatus of claim 11 or 12 wherein the means for obtaining frequency data obtains the frequency data by applying a Gabor transform to the time domain waveform for each pixel.
14. The method according to any one of claims 1 to 10 as used in a pharmaceutical manufacturing process.